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Agricultural Memorandum No. 584

On the probability of establishing a catch forage crop

C V Smith

1. The possibility of establishing a catch forage (brassica) crop in the middle of the growing season is examined on the assumption that current rainfall and current soil moisture deficits provide guidelines and criteria for success. Soil temperature is taken to be non-limiting.

   No precise information is available on the soil moisture requirements for establishment; the limits adopted are therefore arbitrary but hopefully those which most people would regard as reasonable.

2. The problem is seen as falling with 2 phases, the first associated with seedling germination and emergence, the second with seedling establishment.

   Any working of the soil, to remove the previous crop and to establish the forage crop seed bed is assumed to have dried the bare soil in the top layers. Observations indicate that a heavy soil will lose water at the potential transpiration rate, until such times as a soil moisture deficit of the order 25 mm is established. At this point, there is an evaporation check.

   It may be argued that an evaporation check at around 25 mm deficit will be experienced on most soil types [see Agric. Mem. No 580 - I].

   We follow here the changes in soil moisture, in a typical sample of years, of a bare soil with an initial deficit in the top layers of 25 mm on June 1st. The actual crop sowing date is seen as any day on or after June 1st.

   A daily soil moisture balance is struck. Daily potential transpiration values are taken from smoothed weekly means, these weekly means being obtained by fitting a sine curve to the monthly mean values of MAFF Technical Bulletin No 16.

3. The difficulties of seedling germination are taken up by considering that depth of soil which would, at field capacity, hold some 5 mm of soil moisture. For a heavy soil this might imply the top 2.5 cm layer; for a light soil, the top 5 cm layer might be implied.

   Germination and emergent seedling soil moisture requirements are assumed to be met when

   either (i) the soil moisture deficit at the beginning of the day in this top layer is less than 5 mm.

or (ii) the daily rainfall (R) is greater than the long period average daily potential transpiration.

Since an early start to growth is seen as essential to successful cropping, a successful sowing day is defined here as one on which the succeeding 10 days meet seedling germination requirements on at least 6 days. The acceptable interval between days with adequate soil moisture present is taken as 3 days. If an interval of 4 (or more) consecutive days occurs in the 10 days after planting, then the sowing is not regarded as successful.

4. The difficulties of seedling establishment after germination are taken up by considering that depth of soil which would, at field capacity, hold some 25 mm of soil moisture. For a heavy soil this might imply the top 12.5 cm; for a light soil it might imply the top 25 cm.

On any day, the soil moisture requirements of the young plant are assumed to be met, if, at the beginning of the day

either (i) the moisture in this top soil layer is positive (or some specified minimum amount up to 25 mm).

or (ii) the daily rainfall (R) is greater than the long period average daily potential transpiration.

Successful establishment is assumed if, after the 10 day period following a successful sowing, a further 10 day period occurs during which the soil moisture requirement of the young plant are met. For this second 10 day period, the acceptable interval between days with adequate soil moisture is taken as 3 days. If an interval of 4 (or more) consecutive days occurs in the period 11-20 days after a successful sowing, then an adequate fast establishment is presumed not to take place.

5. The data examined are for the years 1952-1967 at Rothamsted. They are considered as representative of the western half of the Eastern Region, ADAS.

Table 1. shows those days when soil moisture conditions would have been adequate to meet seed germination requirements on our definition.

Table 1A shows successful sowing days on our definition.

Table 2 shows the individual days regarded as suitable for plant establishment on our definition [which requires in this instance that there should be some soil moisture in the top soil layer that could hold 25 mm available water at field capacity]. Table 2A shows the days of a successful sowing for germination that would be followed by successful plant establishment.

Tables 3, 3A; 4, 4A; 5, 5A; show the corresponding results when the daily soil moisture requirements for plant establishment are raised to 5mm, 10mm, 15 mm respectively [in the soil layer that would hold 25 mm available water at field capacity].

6. Table 1A suggests that the chances of a successful germination (on our criteria) are better in July than in June, and that conditions will generally be more propitious in the first half, rather than in the second half of June, in most

seasons. The chances of success are not high; on any one day (or calendar date) the probability of success ranges from 1 in 4, to 1 in 2.

Table 2A includes the requirements for both successful germination and successful establishment. The establishment criteria are not particularly restrictive. For example they do not specify where, in the soil depth considered, the available soil moisture should be. Nevertheless the chances of success following sowing on a given calendar date range from 1 in 3 to an unacceptable 1 in 15. In individual seasons, the chance of success is greater, but in roughly half the seasons, there is no prolonged spell of suitable days in June.

Tables 3A, 4A, 5A show that as the establishment criteria are progressively raised, the chances of success become minimal.

7. If the chances of success of establishing a successful field sown catch crop are seen as unacceptable on the basis of the data presented in this memorandum, then the options open to the grower would appear to include

(a) the use of weather forecasts to aid in cropping tactics in the current season

(b) the use of cropping strategies which ease climatic constraints.

Under (a) only the monthly weather forecast covers the required time interval and an analysis suggests, if June is seen as the critical month, that field requirements will only be met if the monthly forecast indicates rainfall above average. Neither of the 2 alternative rainfall categories, average or below average are likely to provide adequate rainfall amounts or daily rainfall distributions; indeed, on the basis of the years 1956, 57, 58, 63, 65, 66 in Table 2A, expectations must not uncommonly be for more than twice the average rainfall amount in June.

The average rainfall at Rothamsted in June is 42 mm (1.64 inches). That in July is 65 mm (2.56 inches) and obviously an analysis suggests that a more normal rainfall may prove adequate, though rainfall above average is desirable.

Under (b), the availability of irrigation water to carry the seedlings over both emergence and establishment could be considered. Alternatively, an acceptance of the fact that plant establishment is somewhat uncertain with seed sown crops could lead to the decision to plan for and set out nursery raised plants in each and every year.

Meteorological Office
Cambridge
November 1973

TABLE 1 DAYS WITH SOIL MOISTURE ADEQUATE FOR GERMINATION (SHOWN AS X)

JUNE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1952			X			X					X	X	X		
1953	X	X	X	X							X	X	X	X	X
1954				X	X	X	X	X	X	X	X	X	X	X	
1955			X	X	X	X	X	X	X	X	X	X	X	X	
1956			X	X	X	X	X	X	X	X	X	X	X	X	X
1957			X	X			X	X	X	X	X	X			
1958	X	X	X	X					X	X	X	X			
1959	X	X	X	X	X	X		X	X						
1960							X	X	X	X	X		X	X	X
1961	X	X					X			X		X	X	X	X
1962										X					
1963				X	X	X	X	X	X	X	X	X	X	X	
1964	X	X	X	X	X	X	X	X	X			X	X	X	
1965					X		X	X	X		X	X	X	X	X
1966					X	X			X	X	X	X	X		
1967								X							
Sum of occasions	5	5	8	9	8	8	8	10	11	10	11	12	11	9	5

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1952		X													
1953	X	X	X	X		X	X					X			
1954	X								X	X		X			X
1955				X	X	X							X		
1956	X	X				X							X	X	X
1957							X	X	X	X	X	X			X
1958		X		X	X	X	X	X	X	X	X	X	X	X	X
1959									X	X	X	X	X	X	
1960							X	X	X				X		
1961		X									X				
1962		X	X		X						X		X		
1963		X	X	X	X	X			X	X	X		X	X	X
1964		X	X	X	X	X		X							
1965	X	X	X	X		X	X	X	X	X					X
1966	X	X	X	X	X	X	X	X	X	X	X	X			
1967								X	X	X	X	X			
Sum of occasions	5	10	6	7	6	8	6	7	9	8	8	7	7	4	6

JULY

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1952	X	X	X	X	X	X	X	X	X	X	X				X
1953		X			X			X	X		X	X	X	X	X
1954	X		X	X	X	X	X	X	X				X	X	X
1955	X		X	X										X	
1956	X	X	X	X	X			X	X	X				X	
1957	X	X	X	X	X	X					X	X	X	X	X
1958	X	X	X	X	X							X	X		
1959	X								X	X	X	X			
1960				X	X	X	X	X	X	X	X	X	X	X	X
1961		X	X					X			X	X	X	X	X
1962					X				X	X	X		X	X	X
1963	X	X	X	X	X	X	X	X		X		X	X	X	X
1964							X	X		X	X	X	X	X	
1965			X			X	X		X		X	X	X	X	
1966				X	X	X	X			X	X			X	X
1967		X					X								X
Sum of occasions	8	8	9	9	10	7	8	8	8	8	10	8	10	12	10

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1952	X		X	X	X	X									X
1953	X	X	X	X		X	X	X			X	X	X	X	X
1954	X	X	X	X				X	X	X	X	X	X	X	
1955															
1956			X	X	X	X						X	X	X	X
1957	X	X	X	X	X	X	X	X	X	X	X	X	X		
1958	X			X	X	X	X			X	X	X	X	X	X
1959	X										X	X	X	X	X
1960	X	X	X	X	X	X	X	X				X	X	X	
1961	X	X										X			
1962	X		X	X	X	X				X	X	X	X		X
1963			X					X	X						
1964		X	X	X		X					X				
1965				X	X	X	X	X	X	X	X	X	X	X	X
1966	X	X	X	X	X	X	X		X	X	X	X	X	X	X
1967		X	X				X		X			X	X	X	X
Sum of occasions	10	8	11	11	8	10	7	6	6	6	9	12	11	9	9

TABLE 1A DAYS OF A SUCCESSFUL SOWING (SHOWN AS X)

	JUNE 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1952																														X
1953										X	X	X	X	X	X															
1954			X	X	X	X	X	X	X														X	X	X	X	X	X	X	X
1955		X	X	X	X	X	X	X																						
1956		X	X	X	X	X	X	X	X	X	X	X															X	X	X	X
1957		X	X	X	X	X															X	X	X	X	X	X	X	X	X	X
1958																X	X	X	X	X	X	X	X	X	X	X	X	X	X	
1959	X	X																					X	X						
1960						X	X	X																						
1961						X	X																							
1962																														
1963			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1964	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X														
1965				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X												
1966				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X									
1967																														
Sum of occasions	2	5	6	8	8	10	9	8	6	6	6	6	5	5	5	5	4	4	3	3	4	3	5	5	4	4	5	5	5	5

	JULY 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	18	29	3
1952	X	X	X	X	X	X	X	X	X	X	X																			
1953	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	?	?	?	?	
1954	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	?	?	?	?	?	?	
1955																														
1956	X	X																								?	?	?	?	
1957										X	X	X	X	X	X	X	X	X	X	X	X	X	?	?	?	?	?	?	?	
1958											X	X			X	X	X	X	X	X	X	X	X	X	X	?	?	?	?	
1959																						X	?	?	?	?	?	?	?	
1960			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	?	?	?	?	?	?	?	?	?	
1961							X	X	X	X																				
1962				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	?	?	?	?	?	?	?	?	?	
1963	X	X	X	X	X	X	X	X	X																					
1964		X	X	X	X	X	X	X	X	X	X	X																		
1965		X	X	X	X										X	X	X	X	X	X	X	X	X	X	?	?	?	?	?	
1966			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	?	?	?	?	
1967																				X	X	?	?	?	?	?	?	?	?	
Sum of occasions	5	7	8	9	9	8	9	9	9	9	9	8	6	6	8	8	8	8	8	9	?									

TABLE 2 - DAYS WITH SOIL MOISTURE ADEQUATE FOR PLANT ESTABLISHMENT CRITERIA

MOISTURE CONTENT >0 IN TOPSOIL LAYER

	JUNE																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1952			X								X	X																		
1933	X	X	X	X	X						X	X	X	X	X	X	X	X	X	X	X	X								
1954					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
1955			X	X			X	X	X	X	X	X	X	X	X	X			X	X										
1956			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							
1957								X	X	X	X	X	X											X	X	X	X	X		X
1958		X	X	X	X	X	X	X	X	X	X	X							X	X	X	X	X	X	X	X	X	X	X	X
1959	X																								X	X	X	X	X	
1960							X	X	X	X	X	X		X								X	X	X	X	X				
1961	X											X	X	X	X	X	X	X	X	X										
1962																														
1963						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X				X	X
1964	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
1965							X	X	X	X	X		X			X	X	X	X	X	X	X	X	X	X					
1966										X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1967																							X	X	X	X	X	X	X	X
Sum of occasions	4	3	6	5	4	5	8	9	9	10	12	12	10	9	8	9	8	8	10	10	7	7	7	7	9	7	6	5	5	5

	JULY																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1952				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
1933											X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	X
1954			X	X	X	X	X	X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1955			X																												
1956								X	X	X	X	X	X	X	X			X	X	X	X	X						X	X	X	X
1957	X	X	X	X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
1958	X	X	X	X	X	X	X	X	X			X									X				X	X	X	X	X	X	X
1959									X	X	X	X	X	X	X	X	X	X	X								X	X	X	X	X
1960				X	X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
1961		X									X	X	X	X	X	X	X	X	X												
1962													X	X	X			X			X				X	X	X	X	X	X	X
1963	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X															
1964							X	X		X	X	X	X					X													
1965							X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1966	X	X			X	X	X			X									X	X	X	X	X	X	X	X	X	X	X	X	X
1967	X	X	X																			X	X	X	X	X	X	X	X	X	X
Sum of occasions	5	6	6	6	7	6	8	6	8	8	10	11	11	10	11	9	9	11	10	7	9	9	8	7	9	10	11	11	10	9	9

TABLE 2A DAYS OF A SUCCESSFUL SOWING FOLLOWED BY A SUCCESSFUL PLANT ESTABLISHMENT

(Establishment requirements simply of some soil moisture in relevant soil layer)

JUNE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1952																														X
1953																														
1954			X																				X							
1955		X																												
1956		X	X	X	X	X																				X	X	X	X	X
1957																					X	X	X	X		X	X	X	X	X
1958																X	X	X	X	X	X	X	X	X						
1959																														
1960																														
1961																														
1962																														
1963			X	X	X	X							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
1964	X	X	X	X	X	X	X	X	X	X																				
1965				X	X	X	X																							
1966				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
1967																														

JULY

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1952	X	X	X	X	X	X	X	X	X	X	X	?	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	?	?
1953	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	?	—	—	—	—	—	—	—	—	—	—	—	—	—	—	?
1954	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	?	—	—	—	—	—	—	—	—	—	—	—	—	—	—	?
1955																															
1956	X	X																													
1957										X	X	?	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	?
1958											X	X			X	?	—	—	—	—	—	—	—	—	—	—	—	—	—	—	?
1959																															
1960			X	X	X	X	X	X	X	X	X	X	?	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	?
1961																															
1962									X	X	X	X	X	?	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	?
1963																															
1964																															
1965		X	X	X	X	X	X	X	X	X	X																				
1966					X	X	X	X	X	X	X	X	X	?	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	?
1967																															

TABLE 3 DAYS WITH SOIL MOISTURE ADEQUATE FOR PLANT ESTABLISHMENT

CRITERIA

MOISTURE CONTENT ≥ 5 MM IN TOP SOIL LAYER

	JUNE																													JULY																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1952																																																																		
1953	X	X									X				X	X	X	X	X																X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X														
1954					X	X	X	X	X	X	X	X	X	X	X	X	X	X																	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X														
1955			X					X	X		X	X	X	X																			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1956						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																																																
1957									X	X	X													X	X																																											
1958		X	X	X	X	X	X													X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1959																						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1960									X	X															X																																											
1961												X	X	X	X	X	X	X					X	X																																													
1962																																																																				
1963							X		X	X	X	X	X	X	X	X	X	X	X	X																																																	
1964	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																		
1965							X	X	X								X	X			X	X	X																																												
1966										X	X	X	X	X	X	X	X	X	X			X	X	X	X																																												
1967																							X	X	X																																											
Sum of occasions	1	3	4	2	3	4	6	5	8	7	8	7	7	7	7	7	8	8	5	4	3	4	6	6	6	4	4	3	4	5	5	3	3	3	3	4	4	4	6	5	8	9	9	9	9	8	7	4	7	7	6	7	6	6	7	5	9	7	8	7	7

TABLE 3A DAYS OF A SUCCESSFUL SOWING FOLLOWED BY SUCCESSFUL PLANT ESTABLISHMENT

(Establishment requirement of soil moisture > 5 mm in relevant soil layer)

	JUNE																													JULY																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1952																														X	X	X	X	X	X	X	X	X	X																							
1953																																																																		
1954																															X	X	X	X	X	X	X	X	X	X																							
1955																																									X	X	X	X	?																			?
1956		X	X	X																						X																																				
1957																											X	X	X	X											X																							
1958																X	X	X	X	X																																											
1959																								X																																							
1960																																																																
1961																																																															
1962																																																															
1963			X											X	X	X	X	X	X	X	X	X	X	X	X	X	X																																				
1964	X	X	X	X	X	X	X																									X	X	X	X																									
1965																																																															
1966				X	X	X	X	X	X	X	X	X	X	X	X																							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
1967																																																													

TABLE 4 DAYS WITH SOIL MOISTURE ADEQUATE FOR PLANT ESTABLISHMENT

CRITERIA

MOISTURE CONTENT >10 MM IN TOP SOIL LAYER

JUNE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1952																														
1953															X	X	X													
1954					X	X	X	X	X	X	X	X	X	X	X	X	X													
1955								X			X	X																		
1956							X	X	X	X	X	X	X	X	X	X	X	X	X											
1957									X	X															X					X
1958		X	X	X	X																		X	X	X	X	X	X	X	X
1959																														
1960																														
1961												X	X	X	X	X														
1962																														
1963									X	X	X	X	X	X	X		X												X	X
1964	X	X		X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X						
1965							X														X									
1966										X	X	X	X	X			X					X	X	X	X	X	X	X	X	
1967																							X	X	X	X	X	X	X	
Sum of occasions	1	2	1	2	3	2	4	4	5	5	5	7	6	6	6	5	6	2	2	1	2	2	4	4	4	3	3	3	4	3

JULY

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1952						X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X							
1953												X		X													X	X	X	X	X
1954						X									X	X	X	X	X	X					X	X	X	X	X		
1955																															
1956								X	X	X	X								X												
1957		X															X			X	X										
1958	X	X	X	X	X	X																									
1959										X	X	X	X	X	X												X	X	X	X	X
1960												X	X	X		X	X	X	X	X	X	X	X								
1961															X																
1962																										X	X	X	X	X	X
1963	X	X	X			X	X	X	X	X	X																				
1964																															
1965														X	X	X					X	X	X	X	X	X	X	X	X	X	X
1966																			X	X	X								X	X	X
1967																						X	X	X	X	X	X	X	X	X	X
Sum of occasions	2	3	2	1	1	4	2	3	3	4	4	4	3	5	5	4	3	3	5	5	5	4	4	3	3	4	6	6	7	6	6

TABLE 4A DAYS OF A SUCCESSFUL SOWING FOLLOWED BY SUCCESSFUL PLANT ESTABLISHMENT

(Establishment requirements of soil moisture ≥10 MM in relevant soil layer)

	JUNE																				JULY																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1952																														X	X	X	X	X	X	X																											
1953																																																																	
1954																														X	X	X																															
1955																																																																	
1956		X																																																														
1957																																																																
1958																X	X	X	X																																													
1959																																																																
1960																																	X	X	X	X																											
1961																																																																
1962																																																															
1963																																																															
1964	X	X	X	X	X	X	X																																																							
1965																																																															
1966							X	X	X	X	X	X																																																			
1967																																																															

TABLE 5 DAYS WITH SOIL MOISTURE ADEQUATE FOR PLANT ESTABLISHMENT

CRITERIA

MOISTURE CONTENT > 15 MM IN TOP SOIL LAYER

JUNE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1952																														
1953																														
1954					X	X	X	X	X	X	X	X	X	X	X															
1955																														
1956							X	X	X	X	X	X	X	X	X	X	X													
1957																														
1958		X	X	X																			X	X	X	X	X	X	X	X
1959																														
1960																														
1961												X	X	X	X															
1962																														
1963									X	X	X	X	X																	X
1964				X			X	X				X	X	X	X		X	X	X	X	X	X								
1965																														
1966										X	X	X										X	X	X	X	X	X	X		
1967																									X	X	X	X		
Sums of occasions	0	1	1	2	1	1	3	3	3	4	4	6	5	4	4	1	2	1	1	1	1	2	2	2	3	3	3	3	1	2

JULY

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1952						X	X	X	X	X	X	X						X	X	X	X	X									
1953																											X		X	X	X
1954																X	X	X							X	X		X			
1955																															
1956							X	X																							
1957																															
1958	X	X	X	X																											
1959										X	X	X	X	X														X	X	X	X
1960																X	X	X	X	X											
1961																															
1962																										X	X	X	X		
1963						X	X	X	X																						
1964																															
1965														X									X	X	X	X	X	X	X	X	X
1966																															X
1967																						X	X	X	X		X	X	X	X	X
Sums of occasions	1	1	1	1	0	2	2	3	3	2	2	2	1	2	0	2	2	3	2	2	1	2	2	2	3	3	4	5	5	4	5

TABLE 5A DAYS OF SUCCESSFUL SOWING FOLLOWED BY SUCCESSFUL PLANT ESTABLISHMENT

(Establishment requirements > 15 MM in relevant soil layer)

	JUNE																											JULY																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1952																																																												
1953																																																											
1954																																																											
1955																																																											
1956																																																											
1957																																																											
1958																X	X																																											
1959																																																											
1960																																																											
1961																																																											
1962																																																											
1963																																																											
1964	X	X	X	X	X																																																							
1965																																																											
1966							X	X	X		X																																																		
1967																																																											